NOTES ON THE EMBRYOLOGY OF SOME NEW ENGLAND ORCHIDS.

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Spiranthes cernua. — In the December Rhodora I gave a brief account of polyembryony in this species. The embryos (Fig. 1) are of vegetative origin and ecologically are to be classed with bulbils and tubers. It is noteworthy that the apparatus of fruit and seed-coats, which serves most plants for the dissemination of embryos sexually derived, is here put to the same use in the interests of the apogamous off-spring. The plant combines in this process the swiftness of seed-dispersal with the elsewhere slow, but always sure, methods of vegetative propagation.

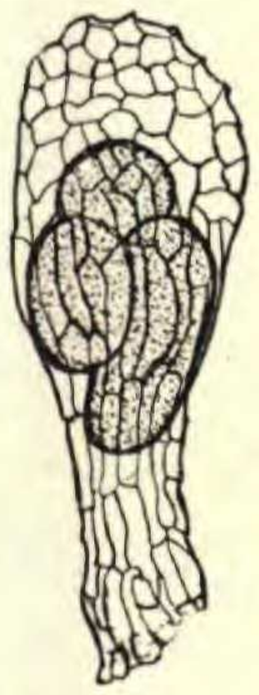

Fig. 1

Heretofore *Coeleboyyne ilicifolia* alone has been known to produce adventive embryos without the stimulus of pollination. With *Spiranthes cernua*, therefore, I took pains to determine whether pollen was needed to make the embryos grow. I took up a plant, which had lately sent up a flower-spike, on which only the six lower flowers were open. From these I drew out the pollinia. The remaining eight flowers were opened and their pollinia were removed with forceps; the pollinia in every case were examined under a lens and found to be whole. In several cases the membranes surrounding the pollen-masses were brought away with the pollen. The potted plant was then placed under a bell-jar in the laboratory, where it was kept until the seeds were ripe; with the result, as already reported, that multiple embryos formed as abundantly and grew to the same dimensions in all the pods as they do upon plants in the fields.

Among orchids polyembryony of this type is known only in this species, I believe. Below will be noted instances in other New England species of the doubling of the embryo in the embryo-sac in the manner already described for several orchidaceous plants.

When the sac and egg-apparatus develop normally, and the egg undergoes fertilization — a condition that I found in a few plants of this species — the resulting embryo within a very few days becomes

large enough to fill the sac. On all sides the tissues are then pushed back. Below — or towards the exostome of the seed — the end of the embryo, where the suspensor should be found, is rounded and is covered only by the remains of the enveloping cells (Fig. 2). At the opposite extremity a recession of the sac is filled with dense protoplasm in which a large and perfect nucleus (*en*) is always present.

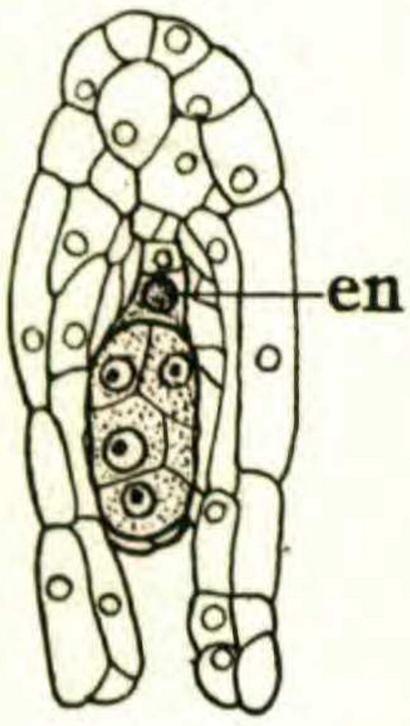

Fig. 2

The question of the origin of this nucleus is of great interest just at the present time. For those who have not freshly in mind the history of the various nuclei of the embryo-sac of angiosperms, it should be said that at a certain stage four nuclei are found at either end of the sac. One nucleus from each of these groups then advances to the centre of the sac. These are termed polar nuclei. They ultimately fuse and the resulting body is the so-called endosperm nucleus, ordinarily to be distinguished by its size and position. The three nuclei remaining at the base of the sac are the antipodals. One of the three at the micropilar end becomes the egg-nucleus; the other two are the nuclei of the synergides. After the inception of the embryo, in most plants the endosperm nucleus divides repeatedly, giving rise to the cells of the endosperm the function of which is to nourish the embryo.

Recently Nawaschin, followed by other observers, has discovered that in some plants at least, one of the male nuclei from the pollen tube takes part with the polars in the formation of the endosperm nucleus. Both male generative cells are thus functional, one combining with the egg, one with the polars. Nawaschin calls this *double fertilization*. The discovery is regarded as one of the most interesting of recent years.

In following the fertilization of some tropical orchids Nawaschin has come to the conclusion that there is no fusion of polars and male; that though the three come to lie in a close group, no actual union occurs. This appears to Nawaschin to explain the absence of endosperm in Orchidaceae.

Strasburger long ago described the nuclear changes in the embryo-sac of several native orchids, and specifically affirmed the fusion of the polars. Now he has reëxamined his material and concludes that the extra spermatic nucleus takes part with the

polars in the production of a true endosperm nucleus. In the orchids which he has investigated, therefore, lack of endosperm cannot be charged to the failure of double fertilization.

In normally fertilized *Spiranthes cernua*, after fertilization, a well-formed nucleus of at least twice the size of a single antipodal is to be seen near the middle of the sac. It is this which is pushed to the base of the sac by the growth of the embryo.

In one of my preparations (by paraffine) may be seen a sac containing a very young embryo, the synergides near by, the antipodals in their places, and toward the centre of the sac two nuclei about the size of the antipodals, lying in contact, while between and touching both is a much smaller, deeply staining nucleus presenting the usual appearance of the spermatic nuclei of orchids. Here we have the origin of the large central nucleus clearly indicated.

These facts lead me to suppose that in *Spiranthes cernua* polar fusion and double fertilization give rise to a true endosperm nucleus. Nevertheless, no endosperm in formed. The nucleus remains at the end of the sac where probably, by vitalizing the protoplasm around it, it assists in passing along nutriment to the embryo.

(*To be continued.*)

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NOTEWORTHY PLANTS OF SOUTHEASTERN CONNECTICUT,— II.

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To the observations reported in a former paper (Rhodora, i, 67) the following may be added as a further contribution to our knowledge of the plant life along the southern borders of New England.

Panicum Atlanticum Nash — Franklin, Old Lyme.

Panicum Bicknellii Nash — Lamb's Hill in Norwich.

Panicum Addisonii Nash — Sandy terrace near Pachaug Pond in Griswold.

Panicum Eatoni Nash — Borders of ponds and marshes both fresh and brackish.

Eleocharis diandra Chas. Wright — Shores of Connecticut River and